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Training in Requirements by Collaboration: Branching Stories in Second Life

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Abstract— Training by playing is believed to be an effective strategy for learning. Training games combine educational and technological techniques that help learners to get involved, collaborate and learn in a practical and interactive way. Collaboration is inherent to software requirements elicitation which involves customers, users and developers to achieve an overall goal. In this article, a game entitled TREG that simulates various activities in software requirements workshop is proposed. The trainee interacts with Non-Player Characters and according to the trainee's choice the game reenacts a specific scenario. The social simulation in the game is based on the branching stories genre. Each branching node is described using a scenario-based template. The game was prototyped in Second Life, a virtual world that gives the possibility to create an immersive collaborative educational experience.

Educational game, Branching Stories, Requirements, Second Life

I. INTRODUCTION

Virtual environments are successfully being used in several contexts like educational, social, gaming and commercial. A virtual world is an environment simulated by a computer provided for some specific goals. Second Life is a 3D virtual world opened to the public since 2003 where users have the possibility of creating their part of that world [1]. Gartner reports that 80% of the active users will have a "Second Life" by the end of the 2011 [2]. This offers new challenges and opportunities for educators.

Educational simulations seem to be the new paradigm of knowledge transfer and get students immersed in a topic. Current studies indicate that students are becoming more pragmatic, visual and computer-savvy [3].

There are some efforts in game technology for requirements engineering education that tried to apply the best practices in this discipline and to decrease the gap between industry and academy [4]. Requirements Elicitation is one of the common topics in Requirements Engineering courses. Making a Software Requirements Workshop is one of the ways that helps on elicitation. It is a working session conducted by a facilitator that involves key project stakeholders and is designed to achieve consensus on the

project requirements, review existing requirements or implement new ones [5].

TREG is a game for training in Requirements Engineering which is created in Second Life using its building and scripting possibilities. It was developed using branching stories as the genre game, the Scenario technique for the software specification and state machine diagrams for modeling the behavior of the system elements. A description technique to specify the functionality of a system is Scenario [6] and it is used to describe several situations simulated in the game. All scenarios are connected forming a network of relationships using a branching stories graph. Branching stories is a traditional simulation genre that gives the student the option to answer from multiple choice questions [3]. This answer has a decision impact on where to conduct the trainee among different or alternatives paths to be followed. A state machine diagram shows the dynamic behavior of an entity based on its response to events [7] and it is used in the game to exhibit different sort of behavior of the game objects.

This paper is organized in seven sections. Section 2 gives an overview of games in requirements engineering and some educational games in Second Life. Section 3 presents a description of the game and the techniques combined for designing the game. Section 4 exposes the technology used in the game implementation. Section 5 explains an example of how the game trains in a collaborative workshop session. Section 6 draws some implementation discussions. Section 7 concludes this paper and identifies future work.

II. TRAINING BY PLAYING – RELATED WORK

Oblinger [8] calls this new students' generation the Net Generation (NetGen). NetGen'ers tend to be experiential learners, community-oriented and their learning preferences include teamwork and technology use. Games and simulations are a potential learning environment to create educational engagement for them.

Games are a nontraditional approach for training in requirements engineering [9]. There are some examples in this field but none developed in a virtual world. RE-O-Poly explores best practices in Requirements Engineering using board game based upon Monopoly® [10]. The FAB ATM project, developed by the Deakin University, combines



video-based computer simulation with classroom activities for teaching IT/IS principles and requirements engineering [4].

Virtual worlds can be an effective environment for educational games [11]. Second Life gives the possibility to create different educational content like classes, discussion panels and games [12]. The Ohio University developed two multi-player games in Second Life for software engineering education [13]. The first one based on Groupthink Software Specification Exercise developed at the M.I.T. [14]. Groupthink aims at teaching in a game show style how to write effective specifications. Figure 1 shows an experience of a Groupthink session in Second Life. This game is available to use in-world [15]. The other game was developed based on the SimSE game where students manage a simulated software project [16]. This game is a multiplayer environment which is also available to play in Second Life [17]. Idaho State University also worked in simulation games in Second Life. They created a large scale training game to simulate top exercises in health care and emergency preparedness [18]. Figure 2 shows a hospital scenario where a pandemic flu training exercise was simulated [19].



Figure 1. Groupthink game session



Figure 2. Hospital Scenario in Play2Train

III. DESIGNING THE TRAINING IN REQUIREMENTS ENGINEERING GAME

The Training in Requirements Engineering Game (TREG) is a 3D multiplayer online game which aims at teaching requirements engineering using simulations and collaboration. The expected audience is a stakeholder (students, customers, users or software suppliers) that wants to be trained in this topic. In this phase of the project, we are focusing on training in the workshop technique, a collaborative way for gathering and analyzing requirements.

In order to keep the trainees immersed for enhancing their skills through a playful activity, real life metaphors are used for joining a common real life task together with a requirements engineering situation. For example, when the trainee is being trained in the workshop technique, a kitchen metaphor is proposed. The trainee enacts a chef role-play that must find the ingredients for the “making workshops” recipe. Figure 3 shows the part of the environment implemented for this specific technique.



Figure 3. The Kitchen Metaphor and the “Making Workshops” Room

In order to prototype the game, first, the content was conceived taking into account requirements engineering concepts originated from Gottesdiener's book: "Requirements by Collaboration: Workshops for Defining Needs" [5]. There she suggests 14 ingredients for accomplishing a successful requirements workshop. All these ingredients were reorganized using a structure based on the workshop process framework phases: plan, do, check and act. When the trainee chooses one of the ingredients for starting the training session, a situation related to the chosen ingredient is shown to the trainee revealing multiple paths to follow. Most paths lead to "making workshops" that don't really work. Then, collaboration patterns are offered to the trainee for choosing paths that do work. Figure 4 shows the TREG Design Process Box for the training process in the workshop technique. It takes the ingredients as input and the collaboration patterns as output. An example of the "Right People" ingredient and its collaboration patterns is showed in the Section 5.

Then, three implementation strategies were applied to design TREG. The game makes use of the branching stories genre for simulating situations that will immerse the trainee in a workshop scenario that must be planned, conducted and finished. Each node is described using the scenario template for fine tuning the situations specified in the branching stories graph. State machines use these diagrams, i.e., the specifications and transitions annotated in these templates, for modeling the system behavior.

Branching stories is one of the computer-based simulations genres defined by Aldrich [3]. A graph with all the possible scenarios is created using the branching stories genre for connecting and following the sequence of

scenarios. The first trials were done using Storyboards. Unfortunately, this technique didn't work. It consumed too much time for making the images to illustrate the game, instead of generating the content and sequences needed for the unfolding of the game. Branching stories, on the other hand, proved itself as a practical way to do the job. In addition, this simulation genre offers the following possibilities to a student [3]:

- Diverse paths for having a different experience each time it is played;
- Facilitates coaching for in each state it is known exactly where the student is and what information will be useful;
- The student learns every time a decision is taken. The impact of the decisions will help to understand the workshop techniques;
- Feedback is given at the end of the path. Scores help to understand the impact of the decisions; and
- The possibility of trying and failing.

Scenario is a description technique useful for depicting situations in an environment suitable for elicitation and specification of software requirements [20]. Each node of the branching stories graph will have a description based on a Scenario Template [6]. Moreover, exceptions in the Scenario Template lead to paths that clarify misunderstandings that are normally associated to trainees' choices. Figure 5 shows this template instantiated for the Right People Ingredient. It exposes the initial node in the branching stories for this ingredient.

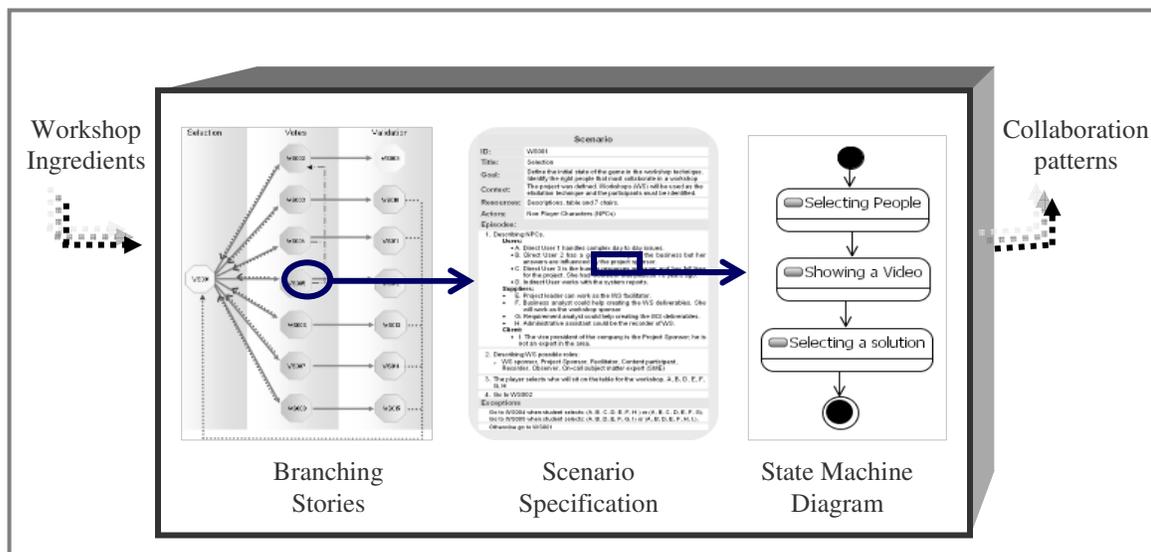


Figure 4. The TREG Design Process Box



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Scenario

ID:	WS001
Title:	Right People Context
Goal:	Define the initial state of the Right People Ingredient in the workshop technique. The trainee must select the Right People for the workshop.
Context:	A new session will start. The trainee role plays as the Workshop Facilitator, 3 participants are seated around the table and 5 are stand in the environment.
Resources:	Boards with descriptions, table and 7 chairs.
Actors:	Trainee, Non Player Characters (NPCs)

Episodes:

1. There is described the project case:
 - o Company Pookysoft sells computers and accessories in the country.
 - o Project purpose: The TREG system will administrate: the stock, the requests (on line and at the store), the product tracking and the customer registration.
 - o Workshop purpose: Identify the primary use cases focus on the sales module.
2. The roles and NPCs characteristics are exposed:
 - o 3 NPCs are seated around the table. These NPCs will participate in the meeting. The Finance Manager as an Indirect User, the Requirement Analyst as a content participant and a Administrative Assistant as the Recorder. There is a chair reserved for the Facilitator (trainee).
 - o 5 NPCs are located in the “Making Workshop” room. The characteristics of these NPCs are presented in Table 1.
 - o The trainee must select 1 of the 4 arrangements of participants for sitting in the 3 free chairs for the workshop:
 - a) Project Sponsor, Direct User 1, Direct User 2
 - b) Project Sponsor, Direct User 1, Workshop Sponsor
 - c) Direct User 1, Direct User 2, Direct User 3
 - d) Direct User 1, Direct User 2, Workshop Sponsor
3. The trainee selects the option c.
4. When 2 go to WS002

Exceptions

Go to WS003 when student selects option a.

Go to WS004 when student selects option b.

Go to WS005 when student selects option d.

Otherwise go to WS001

Figure 5. Scenario Template instantiated for Right People Ingredient

When the specification of the system is generated using the Scenario template, the game behavior can be identified in that documents. There was used State Machine Diagrams for a dynamic perspective of the system. They show the states and transitions of each object of the game and facilitate the

implementation in LSL, a state based language. Figure 6 shows the state machine diagram of the main object of the player HUD in the Right People Ingredient.

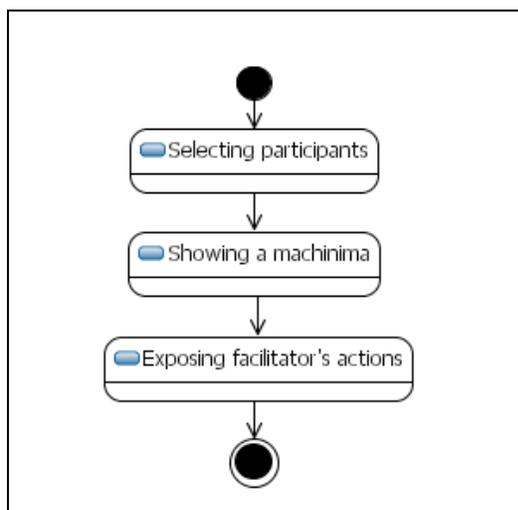


Figure 6. State Machine Diagram of the Heads-Up-Display

Depending on the situations that interactions will take place, Non Player Characters (NPCs) and other objects in the environment maybe inactive or disabled. For example, in Figure 6, given that the game is on the “Selecting participants” state and the NPCs are active and the trainee selects the “Right People”, then, the game transitions to the “Showing a machinima” state. Based on the trainee’s choice, a machinima introduces the problems that a Workshop Facilitator might have, at the same time, disabling the NPCs’ communications feature. When the machinima is over, the game transitions to the “Exposing facilitator’s actions” state and a solution for this specific problem is offered to the trainee.

IV. THE TREG GAME TECHNOLOGY

Second Life is used in this project as the platform where the game is prototyped. This choice was supported because of the immersive and collaborative features inherent to Second Life that are needed for the TREG game. There were used the building capabilities in Second Life to create the main building, metaphor rooms, simulation rooms, NPCs and heads-up-display (HUD). Scripts were used to move the avatars by teleporting between the metaphor rooms, to program the HUD with the game states, to handle the NPCs’ functionalities in the simulation rooms, to communicate objects, and to play videos. The main building includes a reception area, teleporters that transports the trainees to the metaphor rooms and a NPC, a guide in-world. Figure 7 shows Miss Workshop, a specific NPC implemented for guiding the trainee in the playing of the game.

The HUD created for the TREG game controls the scores of the game: main score, investment, time, mission and technique. One can score more points, loose investment and time and move to a next level. This information is registered for following the trainee’s participation in the game.

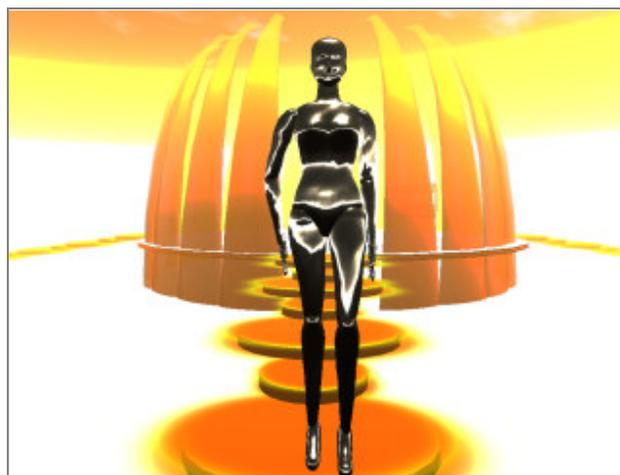


Figure 7. Miss Workshop, the NPC implemented for guiding

The NPC is an object that resembles an avatar but it is controlled by scripts. They are normally used in fictional simulations or role-playing games for interacting with avatars in pre-articulated situations where human beings are dispensable or not available [21]. TREG makes use of NPCs for representing simulations, guiding and shooting machinima videos. The “Making Workshops” Room in Figure 3 shows a workshop session populated by NPCs.

Machinima is a technique that relies on the use of 3D game engines to generate a recorded performance in virtual worlds and uses in-world film techniques where characters and events can be controlled by humans, scripts or artificial intelligence [22]. Machinima was used to film some problematic workshop situations. There, the trainee will watch a machinima showing the consequences of choosing the “Right People”, for example, learning this way a new workshop technique based on a collaboration pattern, if it applies.

V. THE RIGHT PEOPLE INGREDIENT: A GAME PLAY EXAMPLE

Being in the kitchen metaphor room, the trainee must get the necessary ingredients for training in the workshops technique. For this purpose, the trainee walks to the “Making Workshops” room and tries to figure them out interacting with NPCs in a variety of workshop situations. In the Right People situation, the task is to get the right people together at the same time and space for clarifying the requirements. The following example shows the basic information comprising this situation scenario:

- Company: Pookysoft. It sells computers and accessories in all the country.
- Project purpose: The system will administrate the stock, the requests (online and at the store), the product tracking and the customer registration.
- Workshop purpose: Identify the primary use cases focus on the sales module.



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TABLE I. POSSIBLE WORKSHOP PARTICIPANTS.

ID	WS Role	Positions	Pros	Cons
1	Project Sponsor	Vice-president	- Understands the project's purpose and how it will help the organization. - Has financial authority and organizational influence.	- Is not an expert in the area. - Uses to talk a lot and is very persuasive.
2	Direct User 1 (Content Participant)	Human Resources Manager	- Had worked as the principal user for 3 years. - Is the one who knows more about the system.	- Handles complex day-to-day issues.
3	Direct User 2 (Content Participant)	Sales assistant	- Has a good knowledge and experience of the business.	- Is new in the organization. - Is smart but very shy.
4	Direct User 3 (Content Participant)	Production Director	- Has full time for the workshops.	- Sometimes her/his answers are influenced by the Project Sponsor.
5	Workshop Sponsor	Business Analyst	- Has a good relationship with the Project Sponsor. - Has experience as a workshop sponsor	- Just can attend the kick off and the closure.

The “Making Workshops” room shows the workshop environment where there are 4 participants already seated around the meeting table: the trainee plays the Facilitator. The other 3 participants are NPCs sitting for Finance Manager, Requirements Analyst and Administrator Assistant. Then, there are 3 free chairs that must be filled by the Facilitator’s choice. There are 5 NPCs waiting to be interviewed and chosen to participate in the workshop. Table 1 shows the roles that they could assume in the workshop and the pros and cons of having each one at the workshop.

Apparently, there are 10 possible groups of 3 NPCs who can join in the workshop table. However, this number is reduced because of the constraints in the NPCs’ agendas:

- The Human Resources Manager can never schedule a meeting at the same time with the Vice-president.

- The Business Analyst can never schedule a meeting at the same time with the Production Director.

Figure 8 shows the paths the trainee can choose for this ingredient. The first column represents the participants who can be selected by the trainee for joining in the workshop table and each number corresponds to the ID column of Table 1. The ‘Problems’ column shows the problems that take place for this arrangement. At this point, a machinima is presented to the trainee. The ‘Facilitator actions’ column informs the proper actions the trainee should take whenever the problem occurs. These actions are based on the Collaboration Patterns [5], [23]. The highlighted row exposes the option with fewer problems associated.

Participants selected	Problems	Facilitator actions
134	- Project sponsor will not stop talking - Direct User 2 will not talk too much - Direct User 3 will be influenced by the vice-president	- Apply wall of wonder - Stacking. Define participation priorities
135	- Project sponsor will not stop talking - None knows about the old system - WS Sponsor can not attend the meeting	- Reschedule the workshop. Try calling Subject Matter Experts (SMEs) or Content Participants
234	- Direct User 1 handles complex day-to-day issues	- Ask that the Workshop Sponsor with the Project Sponsor for ensuring that all the participants will attend the workshops
235	- WS Sponsor can not attend the meeting	- Try calling another participant which could attend the workshop

Figure 8. Paths in the Right People Ingredient. Problems and Actions



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VI. DISCUSSING THE IMPLEMENTATION

TREG was developed in a prototyping way. Prototyping and Second Life is a good match. The iterative modeling and scripting way of programming in Second Life and the visible objects ensue by them allows the developer to go forwards and backwards in its creation. For example, it was possible to create 3 versions of the main building and afterwards identify that some of the objects and scripts that were not needed were rejected.

The first attempts in the creation of the game were designed using Storyboards. However, it demanded more effort into building than generating the content and its branching. Given that that what was really needed was to find ways to prescribe the sequences of the simulations, branching stories seemed to be a practical way to focus on the content. Overall, it was handy for mapping the interactions, prescribing the sequences and identifying the elements such as the score assigned to each node and the feedback to be provided to the trainee.

By bringing real life elements to the virtual world, TREG fosters a non-traditional training environment. It makes use of metaphors to combine common tasks as cooking in a kitchen with requirements engineering situations for understanding a specific technique. All the objects and scripts were created from scratch using Second Life modeling tools and Linden Scripting Language, for creating objects, machinima and providing behavior to NPCs in order to get a more realistic and personalized game.

VII. CONCLUSION

Second Life has more than 100 educational institutions from over 18 countries. It is an immersive world that allows educators to create 3D environments for training and learning [10]. The TREG game was developed in Second Life using its building and scripting capabilities. It aims at training in requirements engineering using simulated scenarios. As requirements elicitation has collaboration as an inherent feature it was possible to create this environment in Second Life.

Prototyping was used in the development of the TREG game. The look and feel of the game implementation in Second Life facilitates the prototyping process as it shows the elements in-world as-is making it possible to have early visions of the game and figure out the necessity of additional features and functions.

TREG is based on Gottesdiener's book "Requirements by Collaboration". It combines the use of "ingredients" as the best practices in requirements workshops technique. Some ingredients were used in TREG to create problematic workshop situations that needed collaboration patterns for their solutions. TREG offers to the trainee an environment of trial and error by simulating real situations where he performs the role of the main actor.

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